Libby Asbestos Project
Dust Composite Sampling Pilot Study

May 16, 2007
Revision 0

This pilot study is approved for implementation.

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1.0 Introduction

It is generally believed that Libby amphibole asbestos (LA) contamination in indoor dust is likely to be an important contributor to LA contamination in indoor air. However, it is expected that the level of LA in indoor dust (expressed as LA s/cm^2) may not be constant throughout the house, but that there may be differences between sub-locations. If so, then collecting a "representative" sample of dust may be difficult.

Under current procedures (EPA 2003), two dust samples are collected from each floor of a home, each a composite consisting of three 100-cm^2 templates. Typically, the mean of the two samples is used to characterize the dust level on that floor. Thus, the estimate of dust loading for each floor is based on a set of six templates. If dust loading is highly variable, six templates may not be adequate to accurately reflect the floor-wide average dust concentration, and more templates may be needed to ensure the dust sample is representative. In addition, the optimal time spent vacuuming dust from an area into a cassette is uncertain.

Based on these concerns, the purpose of this pilot study is three-fold:

1) Investigate whether or not there is substantial variability in LA levels in dust loading (structures per cm^2) as a function of the "accessibility" of an area, and/or the nature of the surface (porous vs hard). This is based on the hypothesis that dust in poorly accessible areas or porous materials (carpets, upholstery) may tend to build up and retain higher loading levels of LA than dust in readily accessed (and frequently cleaned) areas, especially those areas that are hard surfaces (e.g., linoleum, hardwood floors, etc.). If so, then dust from less accessible areas and/or porous surfaces might be a more important contributor to LA in indoor air than dust in readily accessible areas and/or hard surfaces.

2) Determine if collecting a dust sample based on a large number of templates (30) will yield a sample that is more nearly representative of a floor than a set of 6 templates. If so, the degree of difference in the two approaches (30 point vs 6 point) will be assessed to determine whether the difference in representativeness is large enough to warrant the added time and effort associated with collection of a 30-point sample. This will be done in two ways:

a) Investigate the degree of correlation between the results of the paired (same floor) 30-point composites and the mean of two 3-point composites. If the two methods yield results that are generally similar, it will be assumed that the 30-point composites provide little additional

information compared to the two 3-point approach. If there is a clear and consistent difference between the two approaches, it will be assumed that the 30 point composite provides better representation of the average concentration across the floor.

b) Investigate the relative precision of the two approaches. That is, at a number of properties, two 30-point composites and two sets of two 3-point composites will be collected. The degree of variability between the two 30-point composites and between the means of the two sets of two 3-point composites will be characterized using appropriate statistical methods. If there is little difference in the precision of the two approaches, it will be concluded that there is little additional merit in a 30-point approach compared to the current approach. If there is a meaningful difference, the approach with the lower between-duplicate variability will be considered to be preferable.

3) The current method for collection of dust samples (ASTM D5755) specifies that each dust sampling template be collected over a time period of two minutes (120 seconds). However, no data have been collected at the site to assess whether this time is optimal or not. Therefore, it is important to investigate the potential importance of sample collection time (seconds spent vacuuming each template) as a source of variation in sample results. This will be done by collecting paired 30-point composite samples using 30-second and 120-second vacuuming times per template, and comparing the results of paired samples. If the results are similar, it will be concluded that a 30-second vacuuming time is adequate. If the samples collected using a 120-second vacuuming time tend to be higher, it will be concluded that the two approaches are not equivalent, and that longer vacuuming time yields more complete extraction of LA from the vacuumed surfaces.

2.0 Selection of Sample Locations

Sample points will be collected from areas classified on a scale of accessibility, and secondarily on a scale of surface porosity. This approach was designed by the Environmental Protection Agency (EPA) and used during assessments of residential properties after the World Trade Center (WTC) attacks:

1. **Accessible** areas refer to locations in the home that are readily accessible to residents on a routine basis. These areas are the most likely to be the locations of routine exposure, and are also the most likely to undergo routine cleaning. For the purposes of this pilot study, accessible areas are stratified into two sub-categories: porous surfaces (e.g., carpet, upholstered furniture, drapes, etc.), and non-porous surfaces (linoleum floors, hardwood floors, counter tops, etc.).

2. **Infrequently accessed** areas refer to locations that residents access only intermittently. These are areas where dust cleaning will be less frequent and

where dust (and LA) may accumulate. This includes areas on tops of shelves, entertainment centers, and refrigerators, etc.

3. **Inaccessible** areas refer to locations that residents access only on a very infrequent basis, such as behind refrigerators or other large infrequently moved objects. These areas are likely to be cleaned very rarely, and hence may be locations where LA may have built up over an extended period of time.

To the extent possible, the sub-sample locations will be collected from each type of accessibility area as indicated below:

1. **Porous Accessible** target areas, if present, and in order of priority:
    a. Carpeted flooring at the main entrance used by occupants
    b. Carpeted flooring at the secondary or less heavily used entrance to the home
    c. Carpeted flooring in the center of the living room or family room
    d. Carpeted flooring in the center of bedrooms
    e. Carpeted flooring in an acknowledged or evident route of high traffic (i.e., hallway or other thoroughfare)
    f. Carpeted flooring in the kitchen
    g. Upholstered furniture in any frequently used room
    h. Drapes or curtains in any frequently used room

2. **Non-Porous Accessible** target areas, if present, and in order of priority:
    a. Un-carpeted flooring at the main entrance used by occupants
    b. Un-carpeted flooring at the secondary or less heavily used entrance to the home
    c. Un-carpeted flooring in the center of the living room or family room
    d. Un-carpeted flooring in the center of bedrooms
    e. Un-carpeted flooring in an acknowledged or evident route of high traffic (i.e., hallway or other thoroughfare)
    f. Un-carpeted flooring in the kitchen
    g. Kitchen counter tops
    h. Table tops in the following rooms: dining room, living room, or family room
    i. Table tops (e.g., night stands, bureaus) in bedrooms
    j. Window sills in the dining room, living room, or family room
    k. Window sills in the bedrooms

3. **Infrequent** target areas, if present, and in order of priority:
    a. Top of the refrigerator, when top is exposed
    b. Top of bookshelves
    c. Shelves of bookshelves
    d. Top of the hot water heater
    e. Beneath the sofa or other large pieces of furniture in the living room
    f. Beneath the bed or other large pieces of furniture in bedrooms

g. Inside kitchen cabinets most frequently accessed

4. **Inaccessible** target areas, if present, and in order of priority:
    a. Beneath infrequently moved heavy appliances (e.g., refrigerator, washing machine, etc.)
    b. Inside forced air floor or ceiling vents in the living room
    c. Inside forced air floor or ceiling vents in the bedrooms
    d. Corners of closets or other similar small areas not frequently accessed or cleaned

3.0 Sample Collection

At least 16 samples will be collected from each of 10 properties. At each property, all samples will be collected from one floor (most often the first floor). These samples consist of the following:

- **Accessible** target areas (porous surfaces): One (parent) sample and one field duplicate sample, each collected as a 12-point composite to represent frequently accessed areas with porous surfaces on the selected floor

- **Accessible** target areas (non-porous surfaces): One (parent) sample and one field duplicate sample, each collected as a 12-point composite to represent frequently accessed areas of non-porous surfaces on the selected floor

- **Infrequent** target areas: One (parent) sample and one field duplicate sample, each collected as a 12-point composite, to represent infrequently accessed areas on the selected floor

- **Inaccessible** target areas: One (parent) sample and one field duplicate sample, each collected as a 6-point composite, to represent inaccessible areas on the selected floor. If 6 inaccessible sub-sample locations cannot be identified, the total number of sub-samples can be reduced as long as all available areas are included in the sub-samples. This must be clearly documented in the field log book and field sketches of sampling locations.

- **Whole-Floor Composite (30-second sampling):** One primary (parent) sample and one field duplicate sample, each a 30-point composite sample, will be collected from 30 templates placed in locations selected to represent the entire floor. The sampling locations will be semi-random, but should include at least 2-4 templates from inaccessible areas, and should include templates from 10-15 accessible porous surface locations, prioritized when possible to include a) carpet in entryways, frequently used rooms, and high traffic areas, b) upholstered furniture, and c) draperies/curtains in the living room or in other rooms of the floor. The remaining 11 – 18 template locations should be selected from accessible non-porous areas or from infrequently accessed areas. Each of the 30 templates will be collected using a vacuuming time of 30 seconds. The sampler should strive to make three collection passes per template during the 30 second interval. For purposes of consistency, each of these 30-point composites should be collected using three cassettes, each a

composite of 10 template areas. However if, any flow rate reduction is observed, collection of the sample on the existing cassette should be terminated and a new cassette should be substituted.

- **Whole-Floor Composite (120-second sampling):** One primary (parent) sample and one field duplicate sample, each a 30-point composite sample, will be collected as described above, except that each of the 30 templates will be collected using a vacuuming time of 120 seconds. The sampling locations for these templates should be co-located with the template locations for the 30-second composites (above).

- **High traffic areas:** One primary (parent) sample and one field duplicate, each a 3-point composite, from high traffic areas on the selected floor. Each template in the 3-point composite sample should be collected over 2 minutes according to the current site protocol (EPA 2003).

- **Horizontal surfaces:** One primary (parent) sample and one field duplicate sample, each a 3-point composite, from horizontal surfaces on the selected floor. Each template in the 3-point composite sample should each be collected over 2 minutes according to the current site protocol (EPA 2003).

Each sub-sample point (template) will cover 100 square centimeters (cm^2) using disposable paper templates for measurement. The pilot study will be completed using sampling procedures described in ASTM 5755-03 (ASTM 2003) and the Project-Specific Guidance Document for the collection of dust samples (CDM-LIBBY-10) (unless noted).

- Flow rates – A flow rate of 2 liters/minute should be used for collection of all samples. Flow rates should be verified before sample collection begins and after each template is collected (especially in the case of the 30-point whole floor composite samples). If any flow rate reduction is observed, collection of the sample on the existing cassette should be terminated and a new cassette should be substituted. Samples that are collected on multiple cassettes will be combined at the level of the laboratory to achieve the desired multi-point composite sample.

- Sample Identification – All samples collected as part of this dust pilot study will be given sample numbers that begin with the letters "DP" (dust pilot). When two or more cassettes are needed for a sample, all of the sampling cassettes will be given the same base index ID number as the initial cassette, with the individual cassettes designated with the suffix –a, -b, -c, etc. For example, if a 30-point composite were collected on three cassettes, the three cassettes would be identified as:

  DP-00457-a
  DP-00457-b
  DP-00457-c

- Field Duplicates – Each field duplicate sample specified above will be collected from a template placed immediately adjacent to the location of the parent sample.

4.0 Documentation

For the purposes of the pilot study, a field sample data sheet (Attachment 1) and logbook entry will be completed for each sample collected.

4.1 Field Logbook and Sketch

For logbook entries, in addition to information required by CDM SOP 4-1 (Field Logbook Content and Control), the following will be recorded: Index (i.e., sample) ID, specific location and area (in cm^2) of each sub-sample, total flow rate, sample time, and times/flow rates of all calibration checks.

Logbook documentation will also include a sketch of the home and show the approximate location of each template. Each template location will be illustrated with the following notations that indicate the type of target area and the template number:

- AP_1, where "AP" represents Accessible (Porous) target areas and 1 represents the 1st template of the **Porous Accessible** target area sample
- AN_1, where "AN" represents Accessible (Non-Porous) target areas and 1 represents the 1st template of the **Non-porous Accessible** target area sample
- IF_2, where "IF" represents **Infrequent** target areas and 2 represents the 2nd template of the **Infrequent** target area sample
- IN_3, where "IN" represents **Inaccessible** target areas and 3 represents the 3rd template for the **Inaccessible** target area sample
- HT_1, where "HT" represents **High Traffic** target areas and 1 represents the 1st template of the **High Traffic** target area sample
- HS_2, where "HS" represents **Horizontal Surface** target areas and 2 represent the 2nd template of the **Horizontal Surface** target area sample

4.2 Field Sample Data Sheets (FSDSs)

The following guidance should be followed with completing the dust pilot study FSDS:

- Individual start/stop times are not required to be recorded on the FSDS. The initial start time and flow rates will be recorded in the location provided on the FSDS. At the conclusion of sample collection the stop time and ending flow rate will be recorded in the location provided on the FSDS. Care should be taken by the sampler to insure the time required per sub-sample location is carefully monitored. Entries will be completed on the FSDS for total sample collection time.
- When the sample collected is the field duplicate, the parent samples index ID number will be recorded in the field comments section of the FSDS.

- The template duration of the Whole-Floor composite samples should be recorded by circling the correct duration in the space provided in the field comments section.

- The matrix type for the Whole-Floor composite sample should be selected by circling only Whole-Floor composite in the matrix type parameter data item. Details regarding the locations sampled will be detailed in the location details section of the FSDS.

5.0 Sample Custody

All pilot study dust samples will be handled in accordance with current project sample custody procedures.

Chain-of-custody records will be completed by hand, as the data collected to support this effort will not be recorded in the project databases, see Section 7.0).

6.0 Sample Preparation and Analysis

Samples will be prepared for analysis in basic accord with SOP EPA-Libby-08, which describes procedures for the indirect preparation of air and dust samples. In all cases where a composite sample has been collected on more than one filter cassette (this will be the case for 30-point whole-floor composite samples), all cassettes with the same sample index ID number will be combined at the laboratory during sample preparation and analyzed as one sample.

Because all of the samples collected as part of this pilot study are classified as "investigative", all samples should be prepared using the ashing procedure. It is expected that this may help reduce loading of organic debris on the secondary filters, and will help minimize the requirement for multiple dilutions of the sample.

All samples will be analyzed by TEM in accord with method ISO 10312 (ISO 10312:1995(E)) with project-specific modifications LB-000016, LB-000019, LB-000029, LB-000029a, LB-000030, LB-000053, and LB-000066b (CDM 2003). All asbestos structures (including not only LA but all other asbestos types as well) having length greater than or equal to 0.5 um and an aspect ratio ≥ 3:1 will be recorded on the Libby site-specific laboratory data sheets and electronic deliverables.

The target analytical sensitivity for dust samples collected as part of this pilot study will be 20 structures per cm^2. If LA structures are plentiful, the analysis may cease after completing analysis of the grid opening which contributes the 50^{th} LA structure. If neither the target sensitivity nor a count of 50 LA structures are achieved after counting 50 grid openings, the laboratory shall contact EPA/CDM/Volpe for instructions.

7.0 Data Management

All data collected as part of the pilot study will initially not be loaded into the Libby project database or the Libby Field Office (LFO) version of eLASTIC. Instead the entire data set (logbook entries, FSDSs, COCs, and analytical results) will be provided to SRC

via the project eRoom. The need to load data from this pilot study into the main project databases will be determined after the data for this pilot study are evaluated.

8.0 References

ASTM. 2003. Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading. ASTM D5755-03. June 2003.

CDM. 2003. Modifications to Laboratory Activities. 1st Revised December 23, 2003 with ongoing updates.

EPA. 2003. Sampling and Analysis Plan for Indoor Dust, Revision 0. August 7, 2003.

ISO. 1995. Ambient Air – Determination of Asbestos Fibers – Direct Transfer Transmission electron Microscopy Method. ISO 10312:1995(E).